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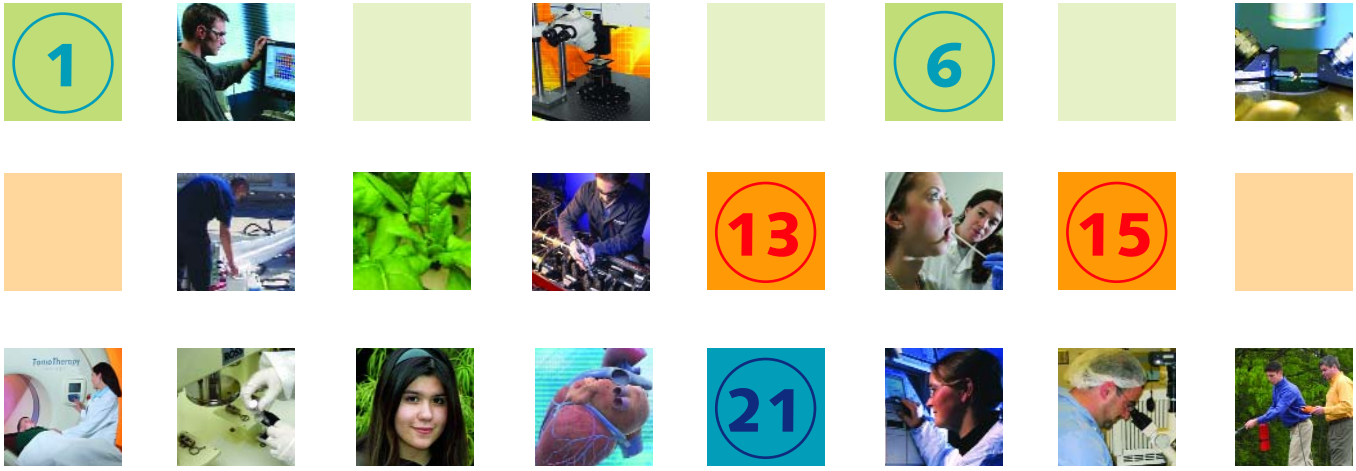

THE BETTER WORLD REPORT *PART ONE*

Building a Stronger Economy:

Profiles of 25 Companies Rooted in Academic Research

2007 Edition
www.betterworldproject.net

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Photo courtesy of Symyx Technologies, Inc.

Symyx scientist using Symyx Software and Tools for a research collaboration program.

Chapter 2

Berkeley Lab and Symyx Technologies: A Winning Combination

With its unique approach to materials identification and analysis, Symyx Technologies is helping powerhouse companies worldwide blaze new trails in the realm of research and development.

This is excerpted from AUTM's Better World Report.

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Lawrence Berkeley National Laboratory

Symyx Technologies

Take one brilliant idea, a supportive national laboratory and a savvy technology transfer office, and occasionally the combination will hit the jackpot. It's all quite fitting given that the essence of this story is a technology based on the concept of *combinations.* The key elements, when brought together, resulted in the company Symyx Technologies, Inc., which today generates over $100 million in sales annually.

Symyx was sparked by the innovative research of renowned scientist Peter G. Schultz, Ph.D., who began his career studying DNA, catalytic antibodies and other biological molecules. Professor Schultz was intrigued by the concept that manipulating antibodies in different combinations yielded an exponentially higher number of biological products, thereby opening the door to broader testing for immune-related drugs. As a chemistry professor and principal investigator at the Lawrence Berkeley National Laboratory in Berkeley, Calif., back in the 1990s, he applied the same approach to the growing field of materials sciences.

While conventional materials development involved creating new materials one at a time, and then painstakingly testing each one for desired qualities, analyzing combinations of materials promised to revolutionize the process. Professor Schultz and his colleagues at Berkeley Lab invented and reduced to practice a highly efficient and automated process, called *high throughput,* for simultaneously analyzing 10,000 different materials, or "combinatorial libraries." Using the techniques of miniaturizing and simultaneous parallel processing, they designed a technology that allowed them to identify new materials with specific and desirable physical and chemical properties. These lead compounds were then analyzed and characterized to determine their structure.

The scientists achieved their goal of applying the concept of high throughput research to combinatorial chemistry, and applied it to the discovery of new materials – from magnets and super conductors, to catalysts and polymers. When they published this milestone in 1995, it warranted the cover story of the journal *Science*. That very same year Symyx was founded.

"It was a very broad concept with high risk that needed to be developed and commercialized within an entrepreneurial venture," says Symyx President and CEO Isy Goldwasser. "That's why Symyx was quickly founded to advance this technology."

The full report can be found at betterworldproject.net

New Strategies for Successful Technology Transfer

The partnership between Symyx and the Berkeley Lab Technology Transfer Department was somewhat unusual, but proved to be beneficial to both parties. According to Viviana Wolinsky, licensing manager at the Berkeley Lab, the Symyx-Berkeley license transaction is believed to be the first of its kind whereby a national lab accepted partial payment in the form of equity. This arrangement allowed the startup company, based on the core intellectual property created at the Berkeley Lab, to devote more of its initial capital to developing the promising technology.

"As a Department of Energy lab, we're always keen to make appropriate choices with licensing," says Wolinksy. "We realized that Symyx had a great plan from the start — it made the right choices and has really gone far beyond initial plans."

The original funding for the work was an $80,000 grant to Professor Schultz for his research from Berkeley Lab's Laboratory Directed Research and Development (LDRD) Program. The LDRD program is a source of discretionary funding that awards grants through a scientific and management peer review process for early-stage projects that are directed to the advanced study of hypotheses, concepts, or innovative approaches to scientific problems.

By 1998, Symyx had raised $38.7 million from a variety of private and venture sources, including Alejandro Zaffaroni, Bayer INNOVATION, Chemical and Materials Enterprise Associates, Institutional Venture Partners (which is now Versant Ventures) and Venrock Associates. The company, headquartered in Santa Clara, Calif., went public in 1999 and is listed on NASDAQ.

Chemist using Symyx Software to design and execute experiments. Photo courtesy of Symyx Technologies, Inc.

Today Symyx is an impressive example of a federally funded technology that resulted in a vibrant and profitable startup, creating hundreds of high-value jobs. Symyx has more than 375 employees, the majority of whom are high-level scientists and technical staff.

"We're proud of this job creation, as well as other direct and indirect effects on economic development," says Wolinsky. "Symyx has become a research powerhouse for other businesses both nationally and abroad."

Symyx's performance continues to shine. Last year the company reached over $108 million in revenue. Goldwasser says that as the first company worldwide to offer this technology, it has built a leadership role and therefore gains the most business and

This is excerpted from AUTM's Better World Report.

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Lawrence Berkeley National Laboratory

Symyx Technologies

the most investments. Currently its equity is worth approximately $750 million, a value that has benefited both the Berkeley Lab and other Symyx shareholders.

Impacting the Big Industries

The list of materials and technologies that have emerged from the company's founding technology continues to grow, as does the list of pharmaceutical, chemical, energy and electronics companies that have benefited from Symyx Tools, Software and research services. Two of the company's more prestigious clients are ExxonMobil and Dow Chemical, and each has made a long-term commitment to change its organization to conduct research and development the way Symyx does, according to Goldwasser.

"Industry-leading companies like these don't usually seek help from outsiders, so it's been a big shift for them," he says. "This exemplifies how Symyx has changed an industry that is normally very resistant to change."

The materials that have been developed in the years since Symyx introduced its broad methodology include new polymers, chemical catalysts and specialty formulations. With over 320 issued patents, Symyx has the largest portfolio of any company devoted to high throughput materials discovery.

"Most technologies out of universities and national labs are very early stage technologies that need further nurturing and are not ready to jump out of the lab and into the marketplace," says Wolinksy. "But Symyx was able to take a very early stage technology, and a great concept, and exploit it to its fullest so that it's now providing huge value across an entire panoply of industrial sectors. It's very rewarding to see a licensee that has devoted its resources and creative energies so well."

Goldwasser, who began his involvement with Symyx as a summer student with Schultz, is perhaps most proud of the way in which Symyx is changing the field of materials sciences.

"We have been very profitable and very fast growing for a small company," he says. "What's most impressive for everyone is that we have really achieved what we initially defined as our overall vision — to change the way that research and development is conducted, by making it faster, better and more efficient."

— By Nicole Resnick

The full report can be found at betterworldproject.net

Aeroseal equipment being prepared to inject sealant into an exhaust duct system on the UC-Davis campus in February 2006.

Photo courtesy of Carrier Aeroseal

Chapter 10

Carrier Aeroseal: Sealing Heating and Air Conditioning Leaks from the Inside Out

Aeroseal, now a division of Carrier Corp., revolutionized the process of searching for, and sealing, hidden leaks in heating and air ducts.

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Lawrence Berkeley National Laboratory

Carrier Corp.

Move over duct tape, a new competitor on the market is getting the job done faster and with more energy savings.

Long thought to be the right solution for stopping leaks around hot or cold air ducts, fabric-backed duct tape fails to seal leaks in ducts and pipes, according to Lawrence Berkeley National Laboratory in Berkeley, Calif.

Instead, Aeroseal duct-sealing technology, invented and developed by the Energy Performance of Buildings Group at Lawrence Berkeley National Laboratory, is making waves for its ability to seal more leakage because of its unconventional method of getting at inaccessible leaks.

Each year about $5 billion of energy escapes into thin air due to leaky ducts in American homes. The new technology stops the leaks from the inside of the ducts by coating the leaks with tiny sealant particles. The discovery can benefit virtually anyone with a heating and cooling system by offering increased energy savings and comfort.

Mark Modera, Ph.D., inventor and principal investigator for the research group that developed the technology, is also the principal engineer with Carrier Aeroseal. He points out why it's challenging to maintain a comfortable environment if there are duct leaks.

"You won't have the same degree of comfort in a two-story home that you're trying to cool in summer when you have duct leaks," he explains. "But the Carrier Aeroseal technology allows more air and cooling upstairs and ultimately provides more comfort."

Addressing Energy Costs

Viviana Wolinsky, licensing manager at Berkeley Lab says, "Even in the very early stages of the development, we could see that the duct-sealing technology had far-reaching benefits for everyone interested in decreasing energy costs."

Wolinsky points out that no one wants to pay more for their energy bills than they have to, but when leaky ducts mean you're paying to heat or cool the air outside your home or office, it's doubly frustrating.

"The prospect of being able to make homes and commercial buildings more energy efficient by sealing ducts from the inside, and at the same time making interior environments more comfortable, was exciting from a technology standpoint," she says.

Idea Comes to Life

The first concept for the technology came to Modera in 1987 when it was apparent that the current methods for sealing leaks weren't effective.

"It's difficult, often impossible, to seal duct leaks from the outside when the ducts are in inaccessible locations," says Modera. "When exploring technologies to seal leaks from the inside, I found that sealing leaks in straight pipes is one thing, but too often there are bends and junctions in the ducts and that's where the problem lies."

Modera used his skills as a research scientist to gain information about duct sealing. When he saw a newspaper advertisement touting a company's ability to seal duct leaks, he set up a duct system and invited the company to take a look at it.

"I discovered their method didn't seal the system I showed them," he recalls. "That's when I decided that maybe I could design a technology that would seal ducts from the inside."

Invention Driven by Marketplace Needs

In 1990, the original funding came as part of a multi-year, multi-million dollar Department of Energy (DOE)-sponsored Cooperative Research & Development Agreement between Berkeley Lab and the California Institute for Energy and the Environment, $50,000 of which was for developing duct technology. Subsequent funding of more than $1 million was provided by the Environmental Protection Agency, DOE and the Electric Power Research Institute.

For three years, Modera and a graduate student worked on developing the technology, and in 1993, Modera says, "We figured it out."

Modera explains how the technology works using the analogy of a car driven at high speeds.

"If a car is driven at 90 miles per hour in the city, it will skid out and crash going around the first sharp turn. Similarly, our technology works by using airborne adhesive particles injected into the ducts so that, when they speed up trying to go through a leak, they 'pile up' or 'crash' into the sides of the leak and seal it."

This is excerpted from AUTM's Better World Report.

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Lawrence Berkeley National Laboratory

Carrier Corp.

Carrier Seals the Deal

In 1997, the technology was licensed for use in the residential market as well as for small commercial buildings. The logical next step was to create a business so the technology could reach customers who needed it. By 1997, Dr. Modera began spending about half of his time in the lab so that he could devote enough time to starting the company.

The marketing of Aeroseal, which is the name of the company as well as the product, was initially done through franchises primarily sold to heating and cooling dealers.

In 2001, the business was sold to Carrier Corp., which in turn created the subsidiary, Carrier Aeroseal. Two years later the company obtained a license from Lawrence Berkeley National Laboratory for improved nozzles and was able to offer the same product and service to the non-residential market.

Hospital Sees Benefits from Duct Sealing

When Cleveland's MetroHealth Medical Center hired Karpinski Engineering as a consultant to improve the heating, ventilation and air conditioning systems in its Central Sterilization Department, the firm specified that the Carrier Aeroseal method of duct sealing should be utilized for a portion of existing ductwork on the project.

A previous balance report had shown significant leakage in the hospital's ductwork in this part of the facility.

"We felt that the Carrier Aeroseal technology would be ideal for this project," says Nathan Anderson, a project engineer with Karpinski. "The hospital has an exhaust fan on the roof and ductwork that was originally installed in the 1970s. When originally constructed, this ductwork was enclosed in a shaft and after the leakage was revealed, the duct was inaccessible for sealing."

The first steps involved Modera taking measurements and sealing off the existing exhaust grills, and a sealant was injected from the inside of the ducts.

The technology can block off existing exhaust openings that range from a quarter inch to a half inch in size. The time varies from a few hours to a few days depending on the characteristics of individual heating and cooling systems.

The full report can be found at betterworldproject.net

"With Carrier Aeroseal, it's a computerized, high-tech process," says Anderson. "Once the openings were blocked off, sealing ducts from the inside took just about 30 minutes."

The "after sealing" report at the time the project was completed in April 2006, showed about 85 percent of the leakage had been plugged — 1,570 cubic feet per minute (cfm) leakage prior to sealing, 230 cfm leakage after sealing.

"By specifying Carrier Aeroseal, we accomplished our goal, which was to improve the exhaust airflow rates," says Anderson. "If we had not sealed off the ducts from the inside, there would have been significant demolition work involved to accomplish sealing from the outside because of the inaccessibility to the ductwork."

Meeting the goals of the hospital was paramount for the engineering firm.

"By using this new technology, which has a 10-year warranty, we saved the hospital time and money," says Anderson.

The engineering firm is so satisfied with the technology, it has specified Carrier Aeroseal to seal 21 ducts in another significant Cleveland building.

"The technology is simple, easy and relevant to today's world," says Wolinsky. "Customers realize a demonstrable payback. When they see how much air is escaping in the before-test when compared to after the ducts are sealed, it's a powerful visual."

Between 2003 and 2006 Carrier Aeroseal sealed 20 large buildings ranging from offices to hospitals. The company intends to focus on promoting the technology via a larger launch into commercial markets during 2007 and 2008.

"The driving forces are energy savings and building/system performance improvement," Modera points out. "During the past four years of accelerated testing, the technology has never failed."

— By Sharyn Alden

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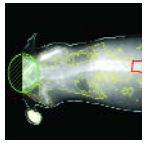















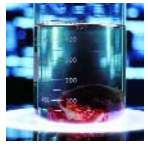

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100 Innovations from Academic Research to Real-World Application

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Software Helps Professionals Design Highly Energy-Efficient Buildings

Lawrence Berkeley National Laboratory

In the 1990s the federal government was eager to replace its outdated software for calculating heating and cooling loads in the buildings it constructed. The U.S. Army Construction Engineering Research Laboratory, the Department of Energy's Office of Building Technologies, University of Illinois at Urbana-Champaign and Lawrence Berkeley National Laboratory teamed up to design EnergyPlus, a stand-alone simulation program.

Launched in 2001, EnergyPlus allows users to calculate the impacts of different heating, cooling, and ventilating configurations and various types of lighting and windows to maximize energy efficiency and occupant comfort. The software can save companies millions of dollars in operational costs over the life of a building, compared to more traditional approaches. EnergyPlus is also being used to evaluate designs for future construction at the World Trade Center site.

Berkeley Lab has developed several different types of licenses to encourage the improvement and widespread adoption of EnergyPlus in the private sector. In addition to 24,000 end-user licensees, nearly 100 universities, research organizations and private-sector companies are acting as collaborative developers, contributing their software improvements to EnergyPlus. EnergyPlus may be freely downloaded from www.energyplus.gov. The U.S. Department of Energy's Drury Crawley manages the development project.

The full report can be found at betterworldproject.net

This is excerpted from AUTM's Better World Report.

Environment

32 Carbon-Monitoring Device Helps Shed Light on Climate Change

Lawrence Berkeley National Laboratory

The scientific community around the world is increasingly focusing its attention on a serious environmental issue affecting us all: global climate change. A significant component of global climate change research entails observing and measuring carbon emissions, which are linked to global warming. Given that roughly 70 percent of the earth's surface is covered by oceans, it stands to reason that understanding their carbon cycles and how those interplay with atmospheric carbon is key to this research.

In response to the need for reliable oceanic data, a researcher at Lawrence Berkeley National Laboratory in Berkeley, Calif., created a remarkable device to measure carbon levels in the far-flung reaches of the world's oceans. The Carbon Explorer was developed by James K. Bishop, a senior scientist at the Lawrence Berkeley Lab, in collaboration with the Scripps Institution of Oceanography in La Jolla, Calif., and WET Labs Inc. in Philomath, Ore. It was funded by the U.S. Department of Energy's Office of Science, the U.S. Office of Naval Research and the National Oceanic and Atmospheric Administration.

This cost-effective robotic ocean float measures carbon concentrations in the ocean, utilizing a system of optical sensors, advanced communications and remote operating capabilities. Thanks to the Carbon Explorer, researchers have, for the first time, the ability to continuously track the biological processes of oceanic carbon cycles.

So far, Carbon Explorers have been sent to some of the most remote and extreme ocean environments in the world, gathering data that previously had not been generated. The Carbon Explorer already has helped reveal shortcomings in our current understanding of climate change. The data provided by this intelligent device will be key to developing effective strategies to curb global warming in the future.

Carbon Explorers are ocean floats with carbon sensors, enhanced communications, and remote programming capacity. They are enabling scientists to track variations in the ocean's carbon cycle year-round with unprecedented accuracy.

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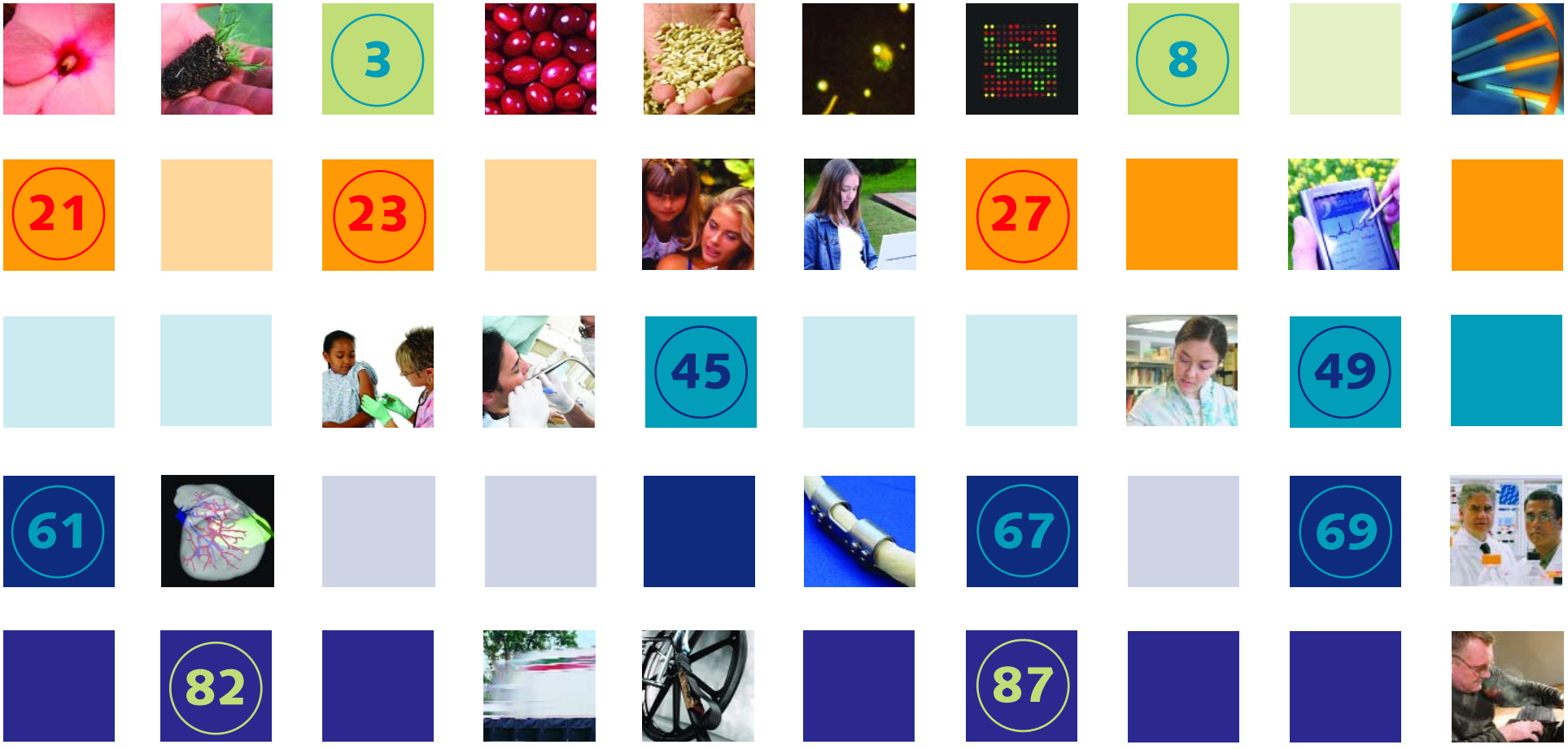

THE BETTER WORLD PROJECT

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From the first spark of wonder and discovery to the final product, these 100 innovations illustrate the impact and benefits of technology transfer. Every day researchers on campuses worldwide are turning new knowledge into products and services, like Pepcid Complete, SunCrisp apple and the Essay Assessor. Look inside and learn how their dedication and curiosity have improved the lives of people around the world.

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